

Tibialis anterior tendon reconstructed with plate and screw



**ASSIGN
BUSTER**

Traumatic Ruptures On The Insertion Of The Tibialis Anterior Tendon Reconstructed With Plate And Screw Fixation Technique And Anterolateral Thigh Flap

Running title: tibialis anterior tendon reconstructed with plate and screw fixation technique

Haijun Mao M. D., Guangyue Xu M. D.

Institution: Orthopedics, The Affiliated Drum Tower Hospital of Nanjing University Medical School, Nanjing, China

Abstract

Objective: Traumatic ruptures of the tibialis anterior tendon are rare but can cause substantial functional deficiencies. This study aimed to evaluate the effectiveness of the reconstruction of traumatic ruptures on the insertion of the tibialis anterior tendon using plate and screw fixation technique and anterolateral thigh (ANTEROLATERAL THIGH) flaps.

Methods: Eight consecutive patients with a traumatic rupture of anterior tibialis tendon on the insertion were managed from February 2008 to February 2012. The insertion was reconstructed with plate and screw fixation technique, and the tissue defects were repaired with ANTEROLATERAL THIGH free flaps.

Results: All flaps survived without any complications. The average preoperative and postoperative American Orthopedic Foot and Ankle Society ankle-hind foot scores of the patients were 51 and 94.7. Good ankle dorsiflexion strength against strong resistance was observed in eight ankles

postoperatively, and a substantial improvement in strength was noted compared with the preoperative examination.

Conclusion: Repairing a ruptured insertion of the tibialis anterior tendon using plate and screw fixation technique and ANTEROLATERAL THIGH flaps was a reliable technique and yielded satisfactory results.

Level of Evidence: Level V, retrospective case series.

Key words: tibialis anterior tendon; plate and screw fixation technique; rupture

Introduction

Ruptures of the tibialis anterior tendon, either traumatic or atraumatic, are uncommon. Traumatic ruptures are caused by an acute trauma accompanied with osseous or soft-tissue injuries in addition to pain and weakness in dorsiflexion of the ankle[1, 2]. Tibialis anterior tendon is important in ankle dorsiflexion³. Ruptures of this tendon can cause functional deficiencies.

A localized pseudotumor is usually present at the anteromedial aspect of the ankle, corresponding to the retracted, ruptured tendon end. Physical examination may include loss of the contour of the tibialis anterior tendon over the ankle and the use of the extensor hallucis longus and extensor digitorum communis to dorsiflex the ankle[2].

Traumatic ruptures are usually accompanied with associated injuries.

Traumatic ruptures of the tibialis anterior tendon that occur in the avascular lesion within 2cm to 3cm of the insertion make an end-to-end suture

<https://assignbuster.com/tibialis-anterior-tendon-reconstructed-with-plate-and-screw/>

impossible because bone reattachment is necessary[1, 3-6]. These ruptures are caused by accidents and result in tissue defects. Consequently, island or free flaps may be required during the repair of the tibialis anterior tendon.

Clear guidelines about the treatment of these injuries are currently unavailable. Reconstruction of this tendon to restore ankle dorsiflexion and inversion includes end-to-end repair, tendon transfer, or allograft augmentation[4, 7-10]. The present study describes a surgical technique using plate and screw fixation with anterolateral thigh (ANTEROLATERAL THIGH) flaps to reconstruct traumatic ruptures of the tibialis anterior tendon.

Patients and Methods

Eight consecutive patients with a traumatic rupture of anterior tibialis tendon on the insertion were managed from February 2008 to February 2012. These patients comprised six males and two females with an average age of 32 (range, 24-46) years. Five and three ruptures involved the right and left legs, respectively.

This study defines traumatic rupture as a rupture that occurred because of direct blunt trauma (e. g., accident) to the tendon accompanied by osseous or soft-tissue injuries. These blunt traumatic cases were accompanied by tissue defects, which were reconstructed with ANTEROLATERAL THIGH free flaps. Early repair (3 weeks after the rupture or less) was performed for all the traumatic cases, and the average time from rupture to surgery was 1.8 (range: 3 days to 3 weeks) weeks.

Rupture of tibialis anterior tendon was diagnosed based on history and physical examination. All patients had functional complaints, including weakness in dorsiflexion or unsteady gait, limping, and increased fatigue with walking. Physical examination included a pseudotumor at the anterior part of the ankle, loss of the normal contour of the tendon, and weak dorsiflexion of the ankle accompanied by hyperextension of all toes. Magnetic resonance imaging was performed to assess the retraction of the tendon and confirm the diagnosis.

All patients were available for follow-up. A retrospective review was conducted on medical records, final patient interviews, and physical examinations at an average of 2 years and 3 months (range: 1 year and 3 months to 4 years) postoperatively of all cases. Postoperative manual strength testing was performed using a 0 to 5 scale (0, no evidence of contractility; 1 (trace), evidence of muscle contraction with no joint motion; 2 (poor), range of motion with gravity eliminated; 3 (fair), range of motion against gravity; 4 (good), range of motion against some resistance; and 5 (normal), range of motion against strong resistance.¹¹ The American Orthopedic Foot and Ankle Society (AOFAS) ankle-hindfoot score was used for preoperative and postoperative evaluation. This 100-point standard rating system is designed to compare the results of different treatment methods in patients with the same disorder. The anti-hindfoot AOFAS scores evaluate pain (50 points), function (including gait, range of motion, and strength) (40 points), and alignment (10 points).¹²

Surgical Technique

<https://assignbuster.com/tibialis-anterior-tendon-reconstructed-with-plate-and-screw/>

All surgical cases were performed under general anesthesia in the affiliated Drum Tower Hospital of Nanjing University Medical School. A small longitudinal incision was made above the superior extensor retinaculum. The extensor retinaculum was left intact if possible to avoid adhesions of the tendon. The proximal ruptured tendon end typically retracted to the inferior edge of the retinaculum or just beneath it.

Debridement was performed for the proximal and distal parts of the tendon. If the tendon could be brought to its insertion, a direct tendon repair was carried out. If the tendon ends could not be approximated or if the tendon could not be apposed onto its insertion site, an interpositional tendon graft, which included plantaris tendon (two cases), extensor digitorum longus tendon (one case), and peroneus tertius tendon (one case), was used to bridge the gap and reinforce repair. An anchor is usually used in most reported literature. However, this study employed plate and screw fixation technique to repair the tibialis anterior tendon to its anatomical insertion.

Direct tendon repairs were performed in four cases. The end of the tibialis anterior tendon was placed on its anatomical insertion, and then a mini-plate was pressed on it and screwed. The harvested grafts had smaller diameter than the tibialis anterior. In most patients, this tendon could be doubled, which usually resulted in a graft with a diameter of 5mm to 6mm. The ankle and foot were held in maximal dorsiflexion and maximal supination, respectively, to determine the final length of the tendon graft. One end of the grafted tendon was fixed using plate and screw fixation technique.

The tendon should surround one screw to ensure a firm insertion. When the bony attachment was performed, the tendons were sutured to each other
<https://assignbuster.com/tibialis-anterior-tendon-reconstructed-with-plate-and-screw/>

with Vicryl using the side-to-side technique. Finally, the tissue defect was repaired with free flaps. In this study, the ANTEROLATERAL THIGH was performed in all cases.

Short-leg cast immobilization was used for the first 2 weeks to maintain the ankle in 0° of dorsiflexion. Weight bearing in the cast was allowed in the succeeding 2 weeks. The duration of cast immobilization was determined in part by the surgeon's perception of repair quality during surgery. At 6 weeks postoperatively, weight bearing and full dorsiflexion were allowed. Plantar flexion was gradually increased.

Results

All ANTEROLATERAL THIGH flaps survived without any complications, such as necrosis and infection, except for bloated appearance. The average preoperative and postoperative AOFAS Ankle-Hind foot scores of the patients were 51 and 94.7, respectively. Active dorsiflexion was possible after 2 weeks to 3 weeks.

Good ankle dorsiflexion strength against strong resistance was observed in eight ankles postoperatively, and a substantial improvement in strength was noted compared with the preoperative examination. All patients were able to walk without a visible limp. However, one patient had a little residual weakness in dorsiflexion in comparison to the uninjured side. On physical examination they still had 5/5 strength. This caused some symptoms of fatigue or pain after prolonged walking. One patient had 4/5 strength result in a little claudication and continued hyperextension of the toes when

walking. Because of the small sample size, there was no valid statistical means to compare the results.

Complications arose in one patient. She developed a regional pain syndrome. At the final assessment, we considered that the adhesion of the intermediate branch of the superficial peroneal nerve may be the cause of complication. After the operation of releasing nerve, the patient reported no residual pain and walked with a normal gait. All patients were satisfied with the final result and would undergo the procedure again.

Case report

A 46-year-old man suffered from a tissue defect and rupture on the insertion of the tibialis anterior tendon from a motor vehicle accident (Figure 1). His preoperative AOFAS Ankle-Hind foot score and ankle dorsiflexion strength were 53 and 3/5, respectively. One week later, a complete debridement was performed. We used the plate and screw technique to reconstruct the tendon insertion without tendon grafting (Figure 2). The defect was reconstructed with ANTEROLATERAL THIGH free flap. After the operation, a short-leg cast was performed. At 2 weeks after the operation, the flap was stable and the wound healed well. At a 14-month follow-up, the postoperative result was 95.3 and the ankle dorsiflexion strength was 5/5 (Figures 3 and 4). He was able to walk without a visible limp.

Discussion

Ruptures of the tibialis anterior tendon are rare but can lead to considerable functional deficiencies. Ouzounian and Anderson[10] reviewed their clinical

<https://assignbuster.com/tibialis-anterior-tendon-reconstructed-with-plate-and-screw/>

experience with 12 patients who had tibialis anterior tendon ruptures. Two types of ruptures were identified based on clinical presentation: (1) atraumatic ruptures, which occurred in low-demand older patients who presented late with minimal dysfunction and (2) traumatic ruptures, which occurred in high-demand younger patients who presented earlier with more disabilities. The authors concluded that patients with traumatic ruptures, regardless of the time of presentation, demonstrated better function after operative intervention.¹³ In our studies, the average age of the patients was 32(range, 24-46) years. Therefore, correct diagnosis should be performed as early as possible.

Delayed diagnosis is common because of intact ankle dorsiflexion that occurs as a result of secondary function of the extensor hallucis longus and extensor digitorum communis muscles[14-17]. The diagnosis is significantly based on physical examination, accompanying by weakness of ankle dorsiflexion and a palpable defect of the subcutaneous portion of the tendon and a pseudotumor at the anterior part of the ankle. A pseudotumor usually corresponds with the retracted ruptured tendon end, which becomes entrapped at the distal extent of the superior extensor retinaculum. Ankle dorsiflexion is weaker than that in the contralateral extremity. A steppage gait is a characteristic but is not universally present.

Conservative treatment with ankle-foot orthoses, bracing, and activity modification is a viable option in inactive patients. However, we speculated that even in cases with a considerable delay, a reconstruction should still be considered regardless of the age of the patients[8].

Several operative techniques have been published. Many reports recommend an end-to-end suture, but most publications report the use of other techniques because of the difficulties of obtaining an adequate suture repair[2, 3, 18]. In cases where tendon stumps are often retracted and undergo degenerative changes, an end-to-end suture does not provide adequate tensile strength to transmit the forces required for function. For such cases, tendon graft is needed. In recent literature, the interpositional autografts used include plantaris tendon, extensor digitorum longus, extensor hallucis brevis, and Achilles tendon[2, 13, 19].

We used ANTEROLATERAL THIGH flaps for the soft tissue reconstruction in these patients. The advantages of ANTEROLATERAL THIGH flaps include consistent and reliable anatomy, long pedicle, being far from the ablative site, allowing two-team approach, the feasibility to create multiple skin paddle by recruiting additional perforators, the flexibility to reconstruct composite defect with chimeric flap by recruiting different tissue types based on a single pedicle, and low donor-site morbidity. When a muscle component is required, we preferred to elevate the flap in a chimeric fashion anterolateral thigh though elevating the flap as a musculocutaneous flap is also a viable option and may decrease the operative time[20].

A suture anchor or a bio-tenodesis screw is often used for the reconstruction of the insertion of the tibialis anterior tendon. However, this study employed the plate and screw fixation technique to reconstruct the insertion because of its several advantages. The screw can fix the tendon to the bone as point, and the plate can fix the tendon as flat. According to the physics formula of $\text{pressure}(p) = \text{force}(f) / \text{square}(s)$, large square results in small pressure when <https://assignbuster.com/tibialis-anterior-tendon-reconstructed-with-plate-and-screw/>

muscle tension is constant. The plate and screw fixation technique may increase the square and decrease the pressure, thereby improving the firmness between the bone and the tendon. Two patients removed the cast a week after the operation. At the last interview, the patients had a manual strength of 5/5 and walked without a visible limp. These results indicate that the technique decreased the duration of cast immobilization compared with previously published reports. However, no valid statistical approach could be performed because of the small sample size. In our future research, we will use a large sample size to validate the results statistically. The applied technique was simple and easy to follow.

During our operation, we tested different directions (perpendicular, parallel, or other angles) of the plate to the tendon and the direction of the muscular contraction. We considered that placing the plate perpendicular to the tendon is relatively easy. We speculated that a shear force exists between the plate and tendon if the plate is parallel to the tendon. In addition, a cutting action may be produced on the tendon after a long time. Thus, we situated the plate perpendicular to the direction of muscular contraction.

This study has few limitations. First, it is retrospective and lacks a control group of nonoperatively managed patients. The results are not representative of all patients with tibialis anterior rupture; this study only included younger patients who were symptomatic. Second, the AOFAS Ankle-Hindfoot score was used as the clinical outcome measurement, which is not a validated instrument. Nevertheless, this study allows comparison of results because AOFAS Ankle-Hindfoot score is also used in other published studies.

Conclusion

We recommend surgical reconstruction of the traumatic ruptured tibialis anterior tendon using plate and screw fixation technique and ANTEROLATERAL THIGH flaps. This technique allows early mobilization and yields satisfactory results.